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Effect of gibberellic acid treatments on flowering of avocado

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ABSTRACT

Gibberellic acid (GA_3) treatments were tested on small trees with the aim of inhibiting flowering. Two GA_3 concentrations (50 and 250 ppm) and various application dates (February to May) were evaluated. Throughout the trial, the high GA_3 concentration gave better results than the low concentration. Single treatments applied early in the season were more successful in postponing flowering than single treatments applied later in the season. However, most promising results were obtained from multiple GA_3 treatments applied during the period February to May.

INTRODUCTION

Alternate bearing is a major problem facing the avocado industry. Avocado trees are prone to heavy flowering and fruit set in some years, followed by a very small crop the following year. Due to large crops in 'on' years, markets become over-supplied and this results in lower net returns to the growers. This problem may be solved by reducing alternate bearing or extending the avocado season.

Gibberellin, a natural plant growth regulator, is known to influence flower development. Flowering was decreased in the 'on' year after gibberellin application to satsuma mandarins (Iwahori & Oohata,1981) and *Citrus sinensis* (Lord & Eckard, 1987). An inhibitory effect on flowering of mango (Núñez-Elisea & Davenport, 1991; Tomer, 1984) was also found. Furthermore, gibberellic acid (GA_3) sprays applied to selected branches of avocado stimulated the production of vegetative shoots (Salazar-García & Lovatt, 1998). According to Salazar-García & Lovatt (1998), GA_3 applications before the beginning of inflorescence initiation, and application to whole trees warrant further investigation. Therefore, the purpose of this study was to test the effect of GA_3 sprays applied to whole trees, on flowering of avocado.

MATERIALS AND METHODS

The trial consisted of 540 small trees (180 each of Fuerte, Hass and Ryan) planted in 8 litres of Westfalia potting mixture, and trees were kept in the open. GA_3, prepared from ProGibb® 4% (Abbott Laboratories), was applied as foliar spray. Two GA_3 concentrations (50 and 250 ppm) were applied as single or multiple treatments, starting

in February and ending in May (Table 1). Control trees were untreated.

Table 1 Dates of single and multiple GA_3 treatments each applied at 50 and 250 ppm

Single Applications
25/02/1999
18/03/1999
08/04/1999
03/05/1999
24/05/1999
Multiple Applications
25/02/1999 + 18/03/1999
25/02/1999 + 18/03/1999 + 08/04/1999
25/02/1999 + 18/03/1999 + 08/04/1999 + 03/05/1999
25/02/1999 + 18/03/1999 + 08/04/1999 + 03/05/1999 + 24/05/1999
Control (untreated)

Vegetative and floral development were evaluated every third week from February to May, and every second week from June to August. A scale of 1-10 was used where 1-5 represented vegetative development (1 = unswollen bud, 5 = fully open flush) and 6-10 flower development (6 = swollen flower bud, 10 = fully open inflorescence). Eight buds per tree were evaluated and the average value calculated. In August it became more meaningful to quantify the ratio between vegetative and flower development considering whole trees. A scale of 1-5 (1 = fully vegetative tree, 5 = tree in full flower) was used. The trial lay-out was a completely randomized design with 10 single tree replicates. Comparison between means was done using Duncan's Multiple range test ($p = 0.05$).

RESULTS AND DISCUSSION

Throughout the trial, similar results were obtained with all three cultivars following GA_3 treatment. GA_3 applied at 50 and 250 ppm gave similar results, however the effect was more pronounced with the high concentration. Therefore, only the results achieved on Hass with the high concentration will be shown. During the period late February until late May trees were in a "dormant" phase without visible signs of development. From then on bud swell occurred and development was quite rapid. At the end of July, the flowering of untreated control trees was in full progress (Figure 1). Development of trees which received a single GA_3 application at the end of February progressed, following the same pattern as the control trees (Figure 1).

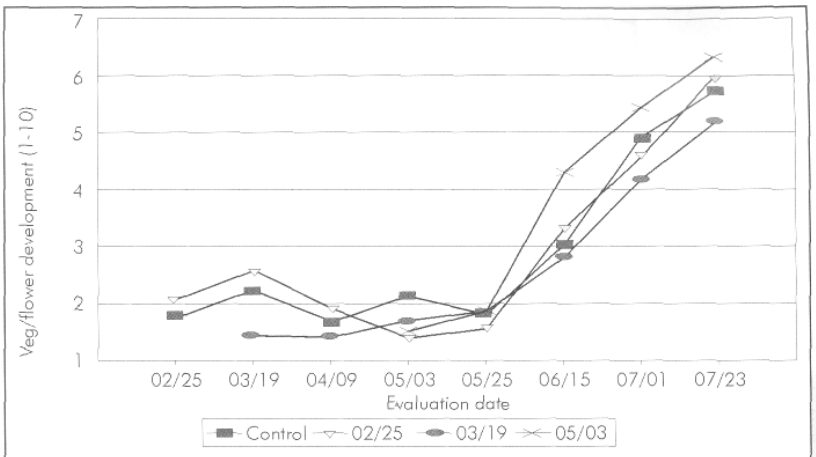

Figure 1 Vegetative and flower development as affected by single GA_3 (250 ppm) treatments at various dates (1 = unswollen vegetative bud, 10 = fully open inflorescence)

A single application in the middle of March inhibited flower development. One GA_3 application to trees at the beginning of May, showed an enhancement of flower development. Early in June buds swelled and by mid-June the first inflorescences started to emerge. In this treatment, GA_3 accelerated the development of flowers that were already differentiated at the time of application. Similar results were obtained in strawberry (Porlingis and Boynton, 1961) and Salazar-García and Lovatt (1998) reported that GA_3 sprays on differentiated flowers of 'Hass' avocado advanced flowering. All multiple GA_3 application treatments inhibited flower development to some extent (Figure 2).

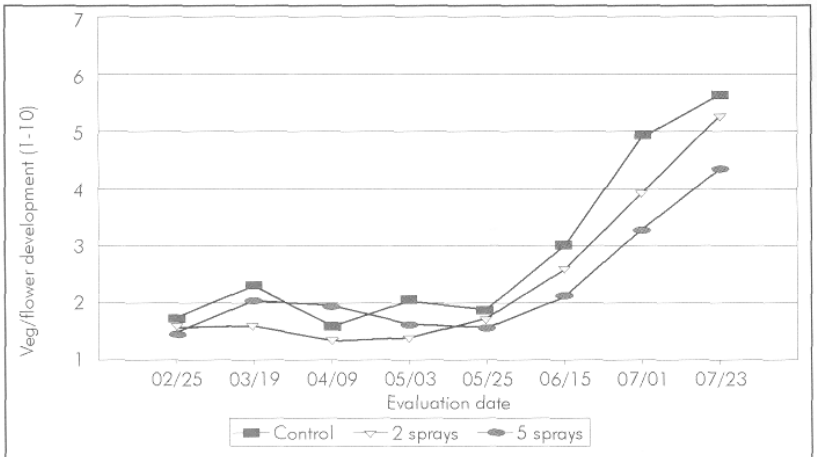

Figure 2 Vegetative and flower development as affected by multiple GA_3 (250 ppm) treatments (1 = unswollen vegetative bud, 10 = fully open inflorescence)

The inhibitory effect was more pronounced with increasing numbers of GA_3 sprays

applied. The strongest inhibition was obtained with a five spray treatment (February + March + April + May + May).

With regard to the ratio between vegetative and reproductive (flower) development (scale 1-5), untreated control trees showed more flower than vegetative development at the end of August (Figure 3).

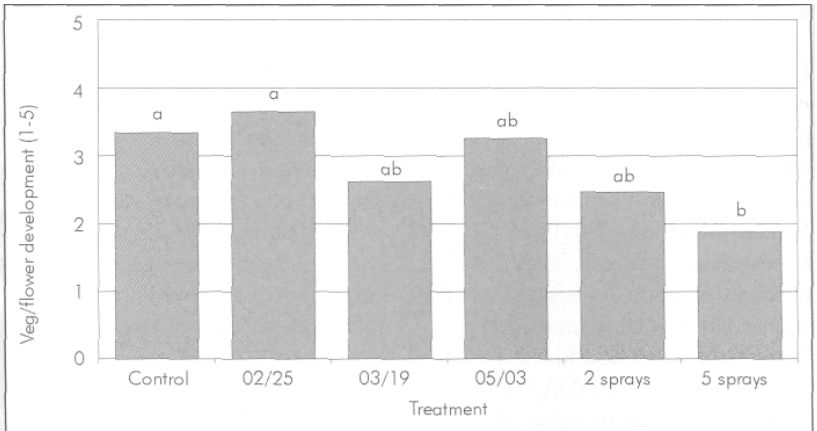

Figure 3 Ratio of vegetative and flower development as evaluated in August 1999 (1 = fully vegetative tree, 5 = tree in full flower)

The ratio of vegetative and reproductive growth for a single application of GA_3 during February was in favour of flower development. Flower development in trees that received GA_3 in the middle of March was inhibited and trees showed more vegetative development. Trees that had a single GA_3 spray at the beginning of May showed more flower than vegetative development. Vegetative development was more pronounced in trees that were treated twice with GA_3 (February + March). No, or very little, flowering was observed in trees that received five GA_3 spray applications (February + March + April + May + May). There is considerable variation within an avocado tree's canopy concerning the stage of flower development, and therefore shoots differ in their response to GA_3 treatment. When GA_3 treatments are spread over a four month period, a greater proportion of flower buds should be inhibited.

In conclusion, this study showed that GA_3 sprays inhibit flowering in avocado. However, timing of the sprays is crucial concerning the type of reaction that can be expected. If flower inhibition is the main aim, e.g. in trees used as nursery budwood source, GA_3 should be applied at flower initiation and during early stages of flower development. Sprays at a later stage during flower development result in enhanced flowering of already differentiated flowers. Research done by Salazar-García and Lovatt (1999) on stem injected GA_3 was promising regarding the reduction of alternate bearing. Due to the high cost of foliar GA_3 applications, stem injections warrant further study.

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